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American Society of Municipal Improvements, 1915

SPECIFICATIONS FOR **Cement Concrete Paving** ADOPTED OCTOBER 14, 1915

These specifications will be modified from time to time to keep them fully up to date. Suggestions as to modifications or additions are solicited and should be sent to the Secretary, or to William J. Hardee, City Engineer, New Orleans, La., Chairman of the Subcommittee on Specifications for Concrete Paving, and—

GEORGE W. TILLSON
Boro Hall, Brooklyn, New York
Chairman of General Committee on Standard Specifications

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SPECIFICATIONS FOR CONCRETE STREET PAVEMENT.

ONE-COURSE PAVEMENT.*

1. Materials.

1. Cement.—The cement shall meet the requirements of the Standard Specifications for Portland Cement, adopted by the American Society for Testing Materials, August 16, 1909, with all subsequent amendments and additions thereto adopted by said Society.

2. Fine Aggregate.—Fine aggregate shall consist of natural sand or screenings from hard, tough, durable crushed rock or gravel, consisting of quartzite grains or other equally hard material graded from fine to coarse, with the coarse particles predominating. Fine aggregate, when dry, shall pass a screen having four (4) meshes per linear inch; not more than twenty-five (25) per cent shall, pass a sieve having fifty (50) meshes per linear inch, and not more than five (5) per cent shall pass a sieve having one hundred (100) meshes per linear inch. Fine aggregate shall not contain vegetable or other deleterious matter nor more than three (3) per cent of clay or loam.

Fine aggregate shall be of such quality that mortar composed of one (1) part Portland cement and three (3) parts fine aggregate, by weight, when made into briquettes, shall show a tensile strength (at seven (7) and twenty-eight (28) days) at least equal to the strength of briquettes composed of one (1) part of the same cement and three (3) parts Standard Ottawa sand by weight. The percentage of water used in making the briquettes of cement and fine aggregate shall be such as to produce a mortar of the same consistency as that of the Ottawa sand briquettes of Standard consistency. In other respects all tests shall be made in accordance with the Report of Committee on Uniform Tests of Cement of the American Society of Civil Engineers.

3. Coarse Aggregate.—Coarse aggregate shall consist of clean, tough, crushed rock or gravel, or slag of approved quality in graded

*Specifications regarding both joints and reinforcement are purposely omitted from these specifications, in order that the freest opportunity may be afforded for their addition, in any particular case, according to the opinions of the engineers in charge under the local conditions.

sizes, free from vegetable or other deleterious matter and containing no soft, flat or elongated particles.

The sizes of the coarse aggregate shall be such as to pass a one and one-half ($1\frac{1}{2}$ ") inch round opening, and shall range from one and one-half ($1\frac{1}{2}$ ") inch down, not more than five (5) per cent passing a one-quarter ($\frac{1}{4}$ ") inch round opening, and with no intermediate sizes removed.

Its "Coefficient of wear" as determined by the "Deval Test" shall not be less than twelve, and its crushing strength shall not be less than twenty thousand (20,000) pounds per square inch.**

2. Proportions.

4. All proportions of cement, fine aggregate and coarse aggregate shall be determined on the basis of volumetric analysis, with a view to obtaining a uniform density for the resulting concrete.

5. An examination of the coarse aggregate to be used shall be made and the voids therein determined. The amount of mortar (fine aggregate and cement mixed with water) to be used shall then exceed these voids in volume by not less than five (5) nor more than ten (10) per cent of the total mass of the coarse aggregate.

6. An examination of the fine aggregate to be used shall be made and the voids therein determined. The amount of cement to be used shall then exceed these voids in volume by not less than five (5) nor more than ten (10) per cent of the total mass of the fine aggregate.

(Added by General Committee.)

In no case shall the volume of fine aggregate be less than one-half the volume of the coarse aggregate, nor shall the proportion of cement to fine aggregate be leaner than one (1) to two (2). A cubic yard of concrete in place shall contain not less than seven sacks of cement.

7. The amount of water to be used shall be determined by trial mixtures with the coarse aggregate, fine aggregate and cement in the proportions as above determined until a satisfactory consistency is obtained in the wet concrete, which consistency shall be such as to permit the concrete to be readily deposited in place and yet hold

**Figures should be suited to local conditions.

its shape when struck off by the template and at the same time not to bring about a segregation of the different sizes of material in handling. Every effort and precaution shall be used to secure a constant uniformity in the consistency of the mix.

3. Sub-Grade.

8. Construction.—The bottom of the excavation or the top of the fill when completed shall be known as the sub-grade and shall be at all places true to the elevation as shown on the plans attached hereto.

The sub-grade shall be brought to a firm, unyielding surface by rolling the entire area with a self-propelled roller weighing not less than five (5) nor more than ten (10) tons, and all portions of the surface of the sub-grade which are inaccessible to the roller shall be thoroly tamped with a hand tamp weighing not less than fifty (50) lb., the face of which shall not exceed one hundred (100) sq. in. in area. All soft, spongy, or yielding spots and all vegetable or other perishable matter shall be entirely removed and the space refilled with suitable material.

When considered necessary or of assistance in producing a compact, solid surface, the sub-grade before being rolled shall be well sprinkled with water.

When the concrete pavement is to be constructed over an old pavement composed of gravel or macadam, the latter shall be entirely loosened and the material spread for the full width of the pavement and rolled. All interstices shall be filled with fine material and rolled to make a dense, tight surface.

9. Acceptance.—No concrete shall be deposited until the sub-grade is checked and accepted by the engineer.

4. Forms.

10. Materials.—Where forms are required, they shall be free from warp, of sufficient strength to resist spring out of shape. Wooden forms shall be of not less than two-inch stock.

11. Setting.—The forms shall be well staked or otherwise held to the established line and grades. Where the curb is to be constructed integrally with the pavement, the upper edge of the side forms shall conform to the top of the curb.

12. Treatment—All mortar and dirt shall be removed from the forms that have previously been used.

13. Precautions shall be taken to prevent leaks thru side forms that would allow the cement or mortar to be carried out of the coarser aggregate along the edges of the roadway.

5. Measuring Materials and Mixing Concrete.

14. Measuring Materials.—The method of measuring the materials for the concrete, including water, shall be one which will insure separate and uniform proportions of each of the materials at all times. A bag of Portland cement (94 lb. net) shall be considered one (1) cu. ft.

15. Mixing.—The materials shall be mixed in a batch mixer of approved type and mixing shall continue after all materials are in the drum for at least one (1) minute at a minimum speed of twelve (12) revolutions per minute. The drum shall be completely emptied before receiving materials for successive batches.

16. Re-Tempering.—Re-Tempering of mortar or concrete which has partially hardened, that is, re-mixing with or without additional materials or water, shall not be permitted.

6. Placing Concrete.

17. Placing Concrete.—Immediately prior to placing the concrete, the sub-grade shall be brought to an even surface. The surface of the sub-grade shall be thoroly wet, but shall show no pools of water when the concrete is placed.

After mixing, the concrete shall be deposited rapidly upon the sub-grade to the required depth and for the entire width of the pavement in successive batches and in a continuous operation without the use of intermediate forms or bulkheads between expansion joints.

In case of a breakdown, concrete shall be mixed by hand to complete the section or an intermediate transverse joint placed at the point of stopping work. Any concrete in excess of that needed to complete a section at the stopping of work shall not be used in the work.

18. Finishing.—The surface of the concrete shall be struck off for the entire width of the pavement and from back to back of integral curbs when used, by means of a template or strikeboard. Any

holes left by removing any material or device used in constructing the joint shall be immediately filled with mortar composed of one (1) part cement and two (2) parts of fine aggregate. Concrete adjoining metal protection plates of transverse joints shall be dense in character and shall be given a smooth finish with a steel trowel for a distance of six (6) in. on each side of the joints.

After being brought to the established grade with the template or strikeboard, the concrete shall be finished from a suitable bridge, no part of which shall come in contact with the concrete. If approved by the engineer, the contractor may use a mechanical striking and finishing machine. The concrete shall be finished with a wood float in a manner to thoroly compact it and produce a surface free from depressions or inequalities of any kind.

The finished surface of the pavement shall not vary more than one-quarter ($\frac{1}{4}$) in. from the true shape.

7. Protection.

19. Curing and Protection.—Excepting as hereinafter specified, the surface of the pavement shall be sprayed with water as soon as the concrete is sufficiently hardened to prevent pitting, and shall be kept wet until an earth or other approved covering is placed. As soon as it can be done without damaging the concrete, the surface of the pavement shall be covered with not less than two (2) in. of earth or other material approved by the engineer, which cover shall be kept wet for at least ten (10) days. When deemed necessary or advisable by the engineer, freshly laid concrete shall be protected by canvas until such covering can be placed.

Under the most favorable conditions for hardening in hot weather, the pavement shall be closed to traffic for at least fourteen (14) days and in cool weather for an additional time, to be determined by the engineer.

At the season of the year when the average temperature is below 50 degrees Fahrenheit, sprinkling and covering of the pavement may be omitted at the direction of the engineer.

The contractor shall erect and maintain suitable barriers to protect the concrete from traffic and any part of the pavement damaged from traffic or other causes, occuring prior to its official acceptance, shall be repaired or replaced by the contractor at his expense, in a

manner satisfactory to the engineer. Before the pavement is thrown open to traffic the covering shall be removed and disposed of as directed by the engineer.

20. Temperature Below 35 Degrees Fahrenheit.—Concrete shall not be mixed or deposited when the temperature is below freezing.

If at any time during the progress of the work the temperature is, or in the opinion of the engineer will, within twenty-four (24) hours drop to thirty-five (35) degrees Fahrenheit, the water and aggregates shall be heated, and precautions taken to protect the work from freezing for at least ten (10) days. In no case shall concrete be deposited upon a frozen sub-grade.

TWO-COURSE PAVEMENT.*

1. Materials.

1. Cement.—The cement shall meet the requirements of the Standard Specifications for Portland Cement, adopted by the American Society for Testing Materials, August 16, 1909, with all subsequent amendments and additions thereto adopted by said Society.

2. Fine Aggregate.—Fine aggregate shall consist of natural sand or screenings from hard, tough, durable crushed rock or gravel, consisting of quartzite grains or other equally hard material graded from fine to coarse, with the coarse particles predominating. Fine aggregate, when dry, shall pass a screen having four (4) meshes per linear inch; not more than twenty-five (25) per cent shall pass a sieve having fifty (50) meshes per linear inch, and not more than five (5) per cent shall pass a sieve having one hundred (100) meshes per linear inch. Fine aggregate shall not contain vegetable or other deleterious matter nor more than three per cent of clay or loam.

Fine aggregate shall be of such quality that mortar composed of one (1) part Portland cement and three (3) parts fine aggregate, by weight, when made into briquettes, shall show a tensile strength (at seven (7) and twenty-eight (28) days) at least equal to the strength of briquettes composed of one (1) part of the same cement and three (3) parts Standard Ottawa sand by weight. The per-

*Specifications regarding both joints and reinforcement are purposely omitted from these specifications, in order that the freest opportunity may be afforded for their addition, in any particular case, according to the opinions of the engineers in charge under the local conditions.

centage of water used in making the briquettes of cement and fine aggregate shall be such as to produce a mortar of the same consistency as that of the Ottawa sand briquettes of Standard consistency. In other respects all tests shall be made in accordance with the Report of Committee on Uniform Tests of Cement of the American Society of Civil Engineers.

3. Coarse Aggregate.—Coarse aggregate shall consist of clean, tough, crushed rock or gravel, or slag of approved quality, in graded sizes, free from vegetable or other deleterious matter and containing no soft, flat or elongated particles.

The sizes of the coarse aggregate shall be such as to pass one and one-half ($1\frac{1}{2}$ ") inch round opening and shall range from one and one-half ($1\frac{1}{2}$ ") inch down, not more than five (5) per cent passing a one-quarter ($\frac{1}{4}$ ") inch round opening.

Its "coefficient of wear" as determined by the "Deval test" shall not be less than twelve (12) and its crushing strength shall not be less than twenty thousand (20,000) pounds per sq. in.**

No. 1 Aggregate for Wearing Course.

No. 1 aggregate for the wearing course shall consist of that portion of the above described coarse aggregate, which, when dry, will pass a one-half ($\frac{1}{2}$ ") inch round opening and contain not more than ten (10) per cent of the fine material which will pass a one-quarter ($\frac{1}{4}$ ") inch round opening.

No. 2 Aggregate for Wearing Course.

No. 2 aggregate for the wearing course shall consist of that portion of the above described coarse aggregate, which will pass a one (1) inch round opening, ranging in size from one (1) inch down and containing not more than five (5) per cent of fine material that will pass a one-quarter ($\frac{1}{4}$ ") inch round opening, and with no intermediate sizes removed.

2. Proportions.

4. All proportions of cement, fine aggregate and coarse aggregate shall be determined on the basis of volumetric analysis, with a view to obtaining a uniform density for the resulting concrete.

**Figures should be suited to local conditions.

5. An examination of the coarse aggregate to be used shall be made and the voids therein determined. The amount of mortar (fine aggregate and cement mixed with water) to be used shall then exceed these voids in volume by not less than five (5) nor more than ten (10) per cent of the total mass of the coarse aggregate.

6. An examination of the fine aggregate to be used shall be made and the voids therein determined. The amount of cement to be used shall then exceed these voids in volume by not less than five (5) nor more than ten (10) per cent of the total mass of the fine aggregate.

7. The amount of water to be used shall be determined by trial mixtures with the coarse aggregate, fine aggregate and cement in the proportions as above determined until a satisfactory consistency is obtained in the wet concrete, which consistency shall be such as to permit the concrete to be readily deposited in place and yet hold its shape when struck off by the template and at the same time not to bring about a segregation of the different sizes of material in handling. Every effort and precaution shall be used to secure a constant uniformity in the consistency of the mix.

(Added by General Committee.)

In the base the volume of the fine aggregate shall not be less than one-half ($\frac{1}{2}$) the volume of the coarse aggregate nor shall the proportion of cement to fine aggregate be leaner than one (1) to two and one-half ($2\frac{1}{2}$). A cubic yard of concrete shall contain not less than five and one-half ($5\frac{1}{2}$) sacks of cement.

In the wearing surface the volume of fine aggregate shall not be less than one-half ($\frac{1}{2}$) the volume of mixture No. 1, nor shall the proportion of cement to fine aggregate be leaner than one (1) to one (1). A cubic yard of concrete for wearing course in place shall contain not less than twelve (12) sacks of cement.

In the wearing surface the volume of fine aggregate shall not be less than one-half ($\frac{1}{2}$) the volume of mixture No. 2, nor shall the proportion of cement to fine aggregate be leaner than one (1) to one and one-half ($1\frac{1}{2}$). A cubic yard of concrete for wearing course in place shall contain not less than eight and one-half sacks of cement.

3. Sub-Grade.

8. Construction.—The bottom of the excavation or the top of the fill when completed shall be known as the sub-grade and shall be at all places true to the elevation as shown on the plans attached hereto.

The sub-grade shall be brought to a firm, unyielding surface by rolling the entire area with a self-propelled roller weighing not less than five (5) nor more than ten (10) tons, and all portions of the surface of the sub-grade which are inaccessible to the roller shall be thoroly tamped with a hand tamp weighing not less than fifty (50) lb., the face of which shall not exceed one hundred (100) sq. in. in area. All soft, spongy or yielding spots and all vegetable or other perishable matter shall be entirely removed and the space refilled with suitable material.

When considered necessary or of assistance in producing a compact, solid surface, the sub-grade before being rolled shall be well sprinkled with water.

When the concrete pavement is to be constructed over an old pavement composed of gravel or macadam, the latter shall be entirely loosened and the material spread for the full width of the pavement and rolled. All interstices shall be filled with fine material and rolled to make a dense, tight surface of the roadbed.

9. Acceptance.—No concrete shall be deposited until the sub-grade is checked and accepted by the engineer.

4. Forms.

10. Materials.—Where forms are required, they shall be free from warp, of sufficient strength to resist springing out of shape; wooden forms shall not be less than two (2) in. stock.

11. Setting.—The forms shall be well staked or otherwise held to the established line and grades. Where the curb is to be constructed integrally with the pavement, the upper edge of the side forms shall conform to the top of the curb.

12. Treatment.—All mortar and dirt shall be removed from the forms that have previously been used.

13. Precautions shall be taken to prevent leaks thru side forms that would allow the cement or mortar to be carried out of the coarser aggregate along the edges of the roadway.

5. Measuring Materials and Mixing Concrete.

14. **Measuring Materials.**—The method of measuring the materials for the concrete, including water, shall be one which will insure separate and uniform proportions of each of the materials at all times. A bag of Portland cement (94 lbs. net) shall be considered one (1) cu. ft.

15. **Mixing.**—The materials shall be mixed in a batch mixer of approved type and mixing shall continue after all materials are in the drum for at least one (1) minute at a minimum speed of twelve (12) revolutions per minute. The drum shall be completely emptied before receiving materials for successive batches.

16. **Re-Tempering.**—Re-tempering of mortar or concrete which has partially hardened, that is, re-mixing with or without additional materials or water, shall not be permitted.

6. Placing Concrete.

Concrete for Base.

17. The concrete shall be mixed with the proper proportions, determined as herein specified, of coarse aggregate, fine aggregate, cement and water.

18. Immediately prior to placing the concrete, the sub-grade shall be brought to an even surface. The surface of the sub-grade shall be thoroly wet, but shall show no pools of water when the concrete is placed.

After mixing, the concrete shall be deposited rapidly upon the sub-grade to the required depth and for the entire width of the pavement in successive batches and in a continuous operation without the use of intermediate forms or bulkheads between expansion joints.

The concrete shall be brought to an even surface, the thickness of the wearing course, below the established grade of the pavement. Workmen shall not be allowed to walk on the freshly laid concrete, and if sand or dust collects on the base, it shall be removed before the wearing course is applied. The reinforcing metal shall be placed upon and slightly pressed into the concrete base immediately after it is placed.

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In case of a breakdown, concrete shall be mixed by hand to complete the section or an intermediate transverse joint placed at the point of stopping work. Any concrete in excess of that needed to complete a section at the stopping of work shall not be used in the work.

7. Concrete for the Wearing Course.

19. Mixture No. 1.—The concrete for the wearing course shall be mixed in the manner and of the proportions hereinbefore described, using for the coarse aggregate No. 1 aggregate for the wearing course hereinbefore specified.

20. Mixture No. 2.—The concrete for the wearing course shall be mixed in the manner and of the proportions hereinbefore described, using for the coarse aggregate No. 2 aggregate for the wearing course, herein specified.

21. Placing.—The wearing course shall be placed immediately after mixing, and in no case shall more than forty-five (45) minutes elapse between the time that the concrete for the base has been mixed and the time the wearing course is placed.

22. Finishing.—The wearing course shall be struck off for the entire width of the pavement and from back to back of integral curbs when used, by means of a template or strike board. Any holes left by removing any material or device used in constructing the joint shall be immediately filled with mortar composed of one (1) part of cement and two (2) parts of fine aggregate. Concrete adjoining metal protection plates at transverse joints shall be dense in character, and shall be given a smooth finish with a steel trowel for a distance of six (6) in. on each side of the joints.

After being brought to the established grade with the template or strikeboard, the concrete shall be finished from a suitable bridge, no part of which shall come in contact with the concrete. If approved by the engineer, the contractor may use a mechanical striking and finishing machine. The concrete shall be finished with a wood float in a manner to thoroly compact it and produce a surface free from depressions or inequalities of any kind. The finished surface of the pavement shall not vary more than one-quarter ($\frac{1}{4}$ ") in. from the true shape.

8. Protection.

23. Curing and Protection.—Excepting as hereinafter specified, the surface of the pavement shall be sprayed with water as soon as the concrete is sufficiently hardened to prevent pitting, and shall be kept wet until an earth or other approved covering is placed. As soon as it can be done without damaging the concrete, the surface of the pavement shall be covered with not less than two (2) in. of earth or other material approved by the engineer, which cover shall be kept wet for at least ten (10) days. When deemed necessary or advisable by the engineer, freshly laid concrete shall be protected by canvas until such covering can be placed.

Under the most favorable conditions for hardening in hot weather, the pavement shall be closed to traffic for at least fourteen (14) days and in cool weather for an additional time, to be determined by the engineer.

At the season of the year when the average temperature is below 50 degrees Fahrenheit, sprinkling and covering of the pavement may be omitted at the direction of the engineer.

The contractor shall erect and maintain suitable barriers to protect concrete from traffic and any part of the pavement damaged from traffic or other causes, occurring prior to its official acceptance, shall be repaired or replaced by the contractor at his expense, in a manner satisfactory to the engineer. Before the pavement is thrown open to traffic the covering shall be removed and disposed of as directed by the engineer.

24. Temperature Below 35 Degrees Fahrenheit.—Concrete shall not be mixed or deposited when the temperature is below freezing.

If at any time during the progress of the work the temperature is or, in the opinion of the engineer will within twenty-four (24) hours drop to thirty-five (35) degrees Fahrenheit, the water and aggregates shall be heated, and precautions taken to protect the work from freezing for at least ten (10) days. In no case shall concrete be deposited upon a frozen sub-grade.

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